

2018 WRF-Chem Tutorial

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Haagen-Smit Prize 2016 awarded to the WRF-Chem paper

1238 citations (Google Scholar)



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Fully coupled “online” chemistry within the WRF model

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The Executive Editors and the Publisher of Atmospheric Environment take great pleasure in announcing the 2016 “Haagen-Smit Prize”, designed to recognize *outstanding papers published in Atmospheric Environment*. The Prize is named in honor of Prof. Arie Jan Haagen-Smit, a pioneer in the field of air pollution and one of the first editors of the International Journal of Air Pollution, a predecessor to Atmospheric Environment.

WRF-Chem

Community effort

**Largest contributing groups:
NOAA/ESRL, PNNL, NCAR**

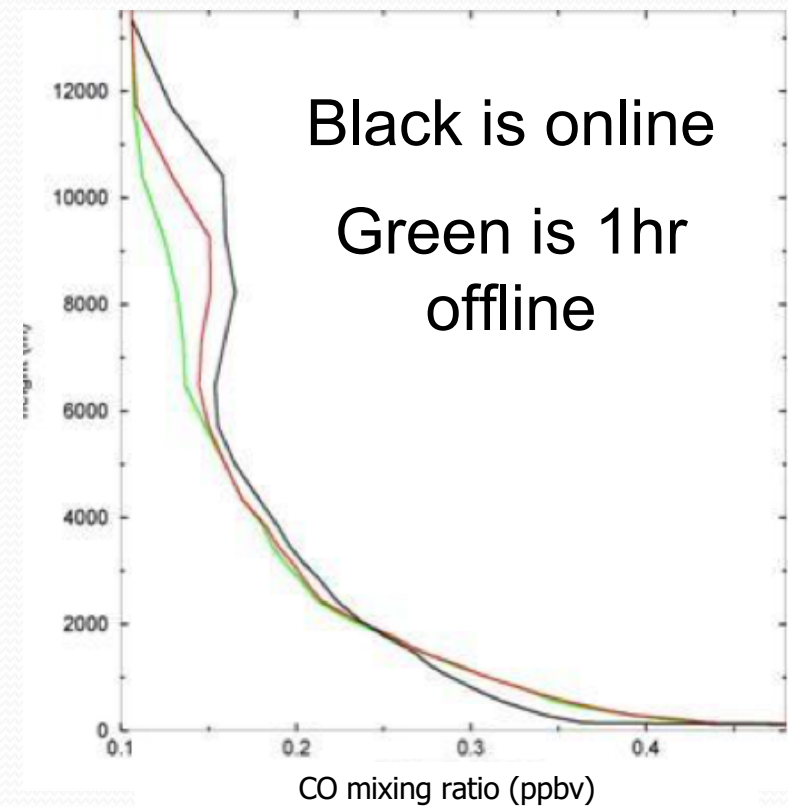
**Other significant contributions
from: National and international
Universities, CPTEC Brazil, NASA,
AFWA**

WRF-Chem

- Chemistry is online, completely embedded within WRF CI
- Consistent: all transport done by meteorological model
 - Same vertical and horizontal coordinates (no horizontal and vertical interpolation)
 - Same physics parameterization for subgrid scale transport
 - No interpolation in time
- Easy handling (Data management)
- Ideally suited to study feedbacks between chemistry and meteorology
- Ideally suited for air quality forecasting on regional to cloud resolving scales

Why Online?

- Offline modeling introduces errors for air quality applications
 - Error for offline modeling is increasing with increasing horizontal resolution
 - Power spectrum analysis can show the amount of information that is lost in offline runs
- 2-way feedback in-between chemistry and meteorology
 - Process studies relevant for global climate change
 - Ultimately it should lead to improved data assimilation (meteorology) and improved weather forecasts



What is needed for this type of modeling system?

1. Advection and diffusion (all done by WRF)
2. Sub-grid scale transport (WRF parameterizations, PBL, convection)
3. Some processes that are specific for chemical constituents, but need meteorology: emissions (biogenic, fire, sea salt, dust, volcanic, anthropogenic), dry deposition, wet scavenging
4. Treatment of chemical reactions, aqueous phase chemistry, gas phase species and aerosols
5. “Chemical” radiation routines (photolysis routines) that provide photolysis rates necessary for (4)
6. Capability of feedback from chemistry to meteorology (meteorological radiation and microphysics parameterizations, possibly also convective parameterizations)

Chemical Data Assimilation

- **WRF DART**
- NCEP's Grid Point Statistical Interpolation (GSI, 3DVAR) assimilation system can be used with surface chemical data as well as with AOD: Significant improvements in forecasts.
- EnKF assimilation system has been used for WRF-Chem
- Work is on-going with hybrid EnKF/GSI system (NOAA/ESRL and NCAR)
- WRF-Chem adjoint development

The 2018 WRF-Chem tutorial: Some additional things to remember

- Community effort with extreme complexity
 - The three main developer groups (ESRL, PNNL, NCAR) may contribute to very different parts of the modeling system, each requiring high levels of expertise
 - These parts are being developed constantly by these groups (their most advanced versions)
 - The community version may lag a bit behind
 - In the future adding new complexity and code into the modeling system may change (see also changes in WRF)

2018 Tutorial

- In addition to our annual tutorial in Boulder we also organize international tutorials
- Because of the complexity of the required various emissions data sets,
 - The tutorials usually do not provide enough time to cover emissions in detail
 - Although we can not provide you the best emissions data, we will freely give you access to any emissions data set and preprocessors that we get our hands on

Some important things to take away

- Check out WRF-Chem references to know who is working on what, what should be cited, and maybe where to get additional help if needed.
- We recommend all the users signing up to the new WRF-Chem discussions email group (forum)
- Also, please send us info on your peer reviewed WRF-Chem publications

Please consider: no support currently exists for preparation of tutorials and documentation. The WRF-Chem help desk is minimally supported.

WRF-Chem info on the WEB:

WRF-Chem web-page: <https://ruc.noaa.gov/wrf/wrf-chem/>

WRF-Chem discussions email list:

<https://list.woc.noaa.gov/cgi-bin/mailman/listinfo/wrf-chem-discussions/>

FAQ: <https://ruc.noaa.gov/wrf/wrf-chem/FAQ.htm>

Publications: <https://ruc.noaa.gov/wrf/wrf-chem/References/WRF-Chem.references.htm>

For questions contact us at **wrfchemhelp.gsd@noaa.gov**

Thank you for coming!

Much success, and we hope you
will enjoy the tutorial, as well as
your time in Boulder!